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FICO CABLES, S.A.

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Mechanism with load sensor for operating a brake

1. Technical Field

The present invention relates to a operating mechanism with load sensor for a brake, in particular for a parking brake-system of vehicles, which is driven by an electric motor, which uniformly operates the brakes and which is supervised by means of a load sensor.

2. Prior Art

Vehicles of different types mostly comprise two different braking systems. One of said braking system serves for reducing the velocity of the vehicle during driving and it is hydraulically or pneumatically operated, for example, via a pedal. The other braking system is used for securing the vehicle during parking. In this brake system, the brakes are mainly operated via brake cables which are set under tensile loads by means of different lever mechanisms in the vehicle compartment. These brakes are also designated as handbrakes or lever brakes.

The prior art provides different solutions of mechanisms for operating parking brakes which are driven either by hand or by foot. Since sometimes substantial forces are needed to operate the parking brake, it is often not applied in the needed extent so that the vehicle can roll away in the parked state. Thereby, a high security risk is generated in traffic. On the other hand, it is also inconvenient for the driver to apply the parking brake with a high effort. For this reason, mechanisms for operating a parking brake were developed which are driven by an electric motor.

Although, it is convenient for the driver to use a parking brake with an electric operating mechanism, the construction of the parking brake and of the operating mechanism has to be protected against potential mechanical overload conditions so that for instance a defect of the motor does not lead to a damage or a destruction of the system. In this context, the WO 98/56633 discloses an electric operating mechanism with load sensor for a parking brake. This arrangement consists of an electric motor for the operation of a setting unit which is used for tightening or releasing a brake cable of a brake. The brake cable is connected with a setting unit via a load sensor so that the force exerted by the setting unit is directly transmitted and determined by the load sensor. It is a substantial disadvantage in this arrangement that the force transmission from the setting unit to the brake cable is disconnected in case of a failure of said load sensor. Therefore, an operation of the brakes is no longer possible which leads to a high risk in traffic. Additionally, the production of said operating mechanism of the present parking brake is expensive due to its complex construction.

It is, therefore, the problem of the present invention to provide an operating mechanism for a brake the construction of which meets higher security requirements and which, even though, comprises a simple construction. It is a further problem of the operating mechanism of the brake to reduce the expenditure of maintenance due to a more compact arrangement of the single components.

3. Summary of the Invention

The present invention solves the above problems by an operating mechanism particularly for a parking brake as defined in claim 1. Further features are included in the dependent claims which separately or in combination represent preferred embodiments.

The mechanism for operating at least one brake, in particular a parking brake, according to the present invention comprises an actuator connected to at least one brake cable and a load sensor for determining the mechanical load of the at least

one brake cable wherein the mechanical load of the at least one brake cable is determined via the actuator in a manner decoupled from the at least one brake cable.

For actuating at least one brake cable, mechanical, hydraulical, pneumatical, or piezoelectric actuators or combinations thereof can be used. While the brake cables are mostly loaded with tensile loads, it is necessary to supervise this mechanical load by means of a load sensor in order to identify the operating condition of the operated brakes and possible overload conditions of the brake cables and of the operating mechanism. To meet higher security requirements, the actuator is directly connected to the brake cable and the mechanical loading of the brake cable is determined via the actuator. Thereby, the force generated by the actuator is not directly transmitted to the brake cable via the load sensor. In case of a failure of the load sensor, the operation of the brakes by the operating mechanism is not affected and, thus, the necessary security is assured, for instance, in traffic.

Said actuator of the present invention changes its position in direction of its longitudinal axis dependent on the mechanical load of the at least one brake cable.

It is the advantage of the present invention that the actuator can carry out a rotation as well as a linear movement. While the rotation is used for operating the actuator, the linear position change can be used for a determination of the load dependent on the mechanical loading of the brake cables. To this end, for example a displacement signal is generated which is calibrated on the mechanical load of the brake cables.

The actuator of the operating mechanism is driven by an electric motor via a gear wherein the actuator comprises a gear wheel, a spindle and a nut.

According to the present invention, preferably, a mechanical actuator is used which changes its length driven by an electric motor. Thereby, the connected

brake cables are actuated and the brakes are operated. The change in length results from a rotating spindle by screwing the nut off the spindle or on the spindle.

Furthermore, a first end of said spindle being complementary shaped to a concentric, profiled opening of said gear wheel and being guided therein so that a rotation of the gear wheel is transmitted to said spindle and that at the same time a displacement of said first end of said spindle is possible in axial direction within said concentric, profiled opening of said gear wheel.

Usually, the acting mechanical loads are indirectly determined via a displacement. Based on the configuration of the first end of the spindle and the opening of the gear wheel according to the present invention, the displacement being necessary for determining the load is carried out by the spindle. As a consequence, the load sensor must no longer be directly integrated in the load transmission from the actuator to the brakes. This arrangement provides improved security which is based on a direct load transmission and a simplified arrangement. In spite of the occurring displacement, the transmission of the rotation of the spindle is not affected since the first end of the spindle is guided in a profiled opening of the gear wheel. Additionally, a stopper is arranged at the first end of the spindle so that the first end of the spindle cannot be completely removed from the gear wheel.

A rotation-decoupled stopper is mounted at a second end of the spindle. This rotation-decoupled stopper comprises a magnet fixing with a magnet. A hall-chip in a hall-chip fixing is arranged opposite of and spaced apart from said magnet wherein a spring is positioned between said magnet fixing and said hall-chip fixing.

A load sensor is arranged near the second end of the spindle which is comprised of a hall-chip and a magnet mounted in an appropriate way, respectively. The distance between the magnet and the hall-chip is changed by the displacement of the spindle whereby an electric signal is generated in the hall-chip due to a varying

magnetic field. The displacement is carried out against the force of a spring having known characteristics which is clamped between the rotation-decoupled stopper and the hall-chip fixing and which provides reference values for the loading of the at least one brake cable.

According to a preferred embodiment of the present invention, the nut comprises a respective inside thread to be guided on a thread of said spindle. Additionally, two Bowden cables are coupled to said nut via coupling facilities being symmetrically arranged to the spindle wherein the Bowden cables are connected to the at least one brake cable.

Due to the configuration of the nut according to the invention, the operation of the connected brake cable is enabled. Furthermore, a symmetrically load distribution on two Bowden cables takes place inside the operating mechanism which realizes an increased operation security of the operating mechanism.

According to a further embodiment of the present invention, the nut is configured as a coupling mechanism comprising a nut with an arc-shaped outer surface and a movable lever mounted thereon. The movable lever comprises coupling facilities for at least two brake cables so that at least two brakes can be directly operated via said actuator.

On the one hand, the said coupling mechanism forms a necessary component of the actuator since it is guided on the spindle and changes its positions in the same way as the nut. Furthermore, the coupling mechanism uniformly distributes the loads on the at least two connected brake cables via the movable lever. Thus, different strains of the brake cables as well as tolerances in the length adjustment of the brake cables are equalized by a simple arrangement.

Furthermore, the operating mechanism comprises microswitches being arranged along the spindle or parallel to said spindle on said housing which are switched by

said nut or by the coupling mechanism and thereby generate a signal which indicates that maintenance has to be carried out. Dependent on the wear of the brakes, the brake cables have to be actuated in a different degree to generate the same braking effect. Accordingly, the nut or the coupling mechanism is screwed on the spindle to different positions in direction of the gear wheel. If the nut or the coupling mechanism reaches a given position on the spindle, a microswitch is operated. Thereby, a respective signal is generated which, for instance, informs the driver to see the garage in order to carry out maintenance work.

4. Short description of the drawing

In the following detailed description the presently preferred embodiments of the present invention are described with reference to the drawing; it shows:

Fig. 1 a perspective general view of the inventive electric operating mechanism according to a first preferred embodiment of the invention;

Fig. 2 a sectional drawing of the preferred actuator with load sensor;

Fig. 3 a top view of the electric operating mechanism according to a first embodiment of the invention wherein the brakes (not shown) are in an applied condition;

Fig. 4 a top view of the electric operating mechanism according to a first embodiment of the invention wherein the brakes (not shown) are in a released condition;

Fig. 5 a top view of the electric operating mechanism having a preferred coupling mechanism according to a further embodiment of the invention.

5. Detailed description of the invention

A first preferred embodiment of the present invention is shown in Fig. 1 in a general view. The operating mechanism 1 for a parking brake contained in a housing 20 comprises as main components an electric motor 5, a gear 10, an actuator 30 and a load sensor 40. The operating mechanism 1 according to the invention can also be used for operating other brake systems than the parking brake. This requires that the signals provided by the load sensor 40 are correspondingly fast evaluated so that the operating mechanism 1 is controlled based on the signal evaluation. The housing 20 serves for the accommodation of the different components of the operating mechanism 1 which are thereby protected against outer influences as, for instance, humidity and mechanical impacts. Thereby, the efforts of maintenance of the operating mechanism 1 are reduced since the damaging, for example, by corrosion is minimized.

The actuator 30 serves for the operation of the brake cables which lead to the respective brakes, for instance, the brakes of the rear wheels. According to a first preferred embodiment of the present invention, the actuator 30 forms a mechanical system which will be described in detail below. As a further solution for an actuator, for instance, hydraulic, pneumatic and piezoelectric systems or combinations thereof are conceivable as long as their performed changes in length are sufficient for operating the respective brake cables.

The mechanical actuator 30 shown in Fig. 1 is driven by an electric motor 5 via a gear 10. The gear 10 serves for an optimal force transmission from the electric motor 5 to the actuator 30 and protects at the same time the electric motor 5 against a mechanical overload.

The load sensor 40 serves for the determination of the mechanical load of the at least one brake cable 60 which is operated via the actuator 30. The load sensor 40 fulfills different functions. On the one hand, it serves for the permanent supervision of the mechanical load of the brake cable 60 in order to provide a reference signal for the condition of the operated brakes (not shown). This information is

especially appropriate if the operating mechanism 1 is also used for the braking during the drive. In cooperation with other systems, thereby for instance, a locking of wheels is prevented in case of a full brake application and the optimal velocity reduction of the vehicle is enabled. Furthermore, a mechanical overload condition of the operating mechanism 1 and the brake cable 60 is indicated by the signal generated by the load sensor 40 so that possible damages or a destruction of the system can be prevented. The load determination is indirectly executed via the compression of a spring 45 as described in detail below. In connection with the actuator 30, however, other systems are also conceivable which, for example, are based on the piezoelectric effect or which uses the resistance or capacity change due to length variation.

Fig. 2 shows a sectional view of a first preferred embodiment of the present invention for a detailed illustration of the actuator 30 with load sensor 40. The actuator 30 is connected with a gear 10 via a gear wheel 31 so that the rotation of the electric motor 5 is thereby transmitted to the actuator 30. The gear wheel 31 comprises a profiled concentric opening 31a for receiving a first end 34a of the spindle 34. The opening 31a is preferably complementary shaped to the first end 34a of the spindle 34 wherein the first end 34a of the spindle 34 is shaped so that at the same time a transmission of the rotation of the gear wheel 31 to the spindle 34 is enabled and a displacement of the spindle 34 in axial direction within the profiled concentric opening 31a of the gear wheel 31. For instance, a trihedral or a square profile are a conceivable profile of the first end 34a of the spindle 34. Furthermore, the spindle 34 comprises a stopper 34c at its outer first end 34a which prevents a pulling out of the spindle 34 of the opening 31a of the gear wheel 31. Additionally, the spindle 34 comprises a thread 34G in its center part guiding a nut 35 with a complementary inside thread. A plate-like stopper 34d is mounted on the second end 34b of the spindle 34. This plate-like stopper 34d is decoupled from the rotation of the spindle 34 by its bearing and serves for the support of the spring 45 of the load sensor 40 against the force of which the at least one brake cable 60 is loaded.

As already mentioned above, the nut 35 is guided on the spindle 34. Since the rotation of the nut 35 is prevented, its actual position is changed in correspondence to the rotation of the spindle 34. As a consequence, the nut 35 is screwed on or screwed off the spindle 34. In this manner, the actuator 30 is shortened or elongated and the brake cable 60 as well as the respective brakes (not shown) are operated. As shown in Fig. 1 according to a first preferred embodiment of the present invention, the mechanical load is transmitted starting from the nut 35 via two Bowden cables 70 to the at least one brake cable 60. Based on this inventive arrangement, the mechanical loads are uniformly distributed on the nut 35. Additionally, this arrangement meets increased security requirements since in case of a failure of one Bowden cable 70 the operating mechanism 1 can still operate. Additionally, based on the inventive arrangement the brakes can be further operated via the operating mechanism 1 even in case of a failure of the load sensor 40. The load is directly transmitted from the nut 35 to the brake cable 60 whereas the load sensor 40 does not work as a coupling or a load transmission component.

For operating the brakes (not shown) via the inventive operating mechanism 1, the spindle 34 is in such a way rotated by means of the gear wheel 31 that the nut 34 changes its axial position in the direction of the gear wheel 31. Due to this position change, the at least one brake cable 60 being directly or indirectly mounted on the nut 35 is applied since the actuator 30 is shortened. The mechanical tensile load of the at least one brake cable 60 is applied against the force of the spring 45 of the load sensor 40 so that the spring 45 is accordingly compressed. The length change of the spring 45 due to the compression is only possible since the spindle 34 can be displaced in axial direction within the opening 31a of the gear wheel 31. The maximum axial displacement of the spindle 34 in direction of the load sensor 40 is limited by the stopper 34c. It is assured by this stopper 34c that in case of a failure of the load sensor 40 the spindle 34 is nevertheless kept in the opening 31a of the gear wheel 31 and thereby an operating of the brakes via the operating mechanism 1 is possible.

The state of applied brakes in the operating mechanism 1 is depicted in Fig. 3 while Fig. 4 shows the state of released brakes in the operating mechanism 1. In comparison to Fig. 4, the nut 35 is actually displaced in direction of the gear wheel 31 in Fig. 3 whereby the actuator 30 is shortened and the at least one brake cable 60 is applied. Based on the mechanical tensile loading of the brake cable 60 which acts on the spring 45 of the load sensor 40 as a pressure load, the spring 45 is compressed since the spindle 34 can be displaced in direction of the load sensor 40. For this reason, the spring 45 is shorter in Fig. 3 than in Fig. 4. When the brake cable 60 is released, the spring 45 expands and the spindle 34 is correspondingly displaced in direction of the gear wheel 31.

Within the load sensor 40, the length change of the spring 45 based on the axial displacement of the spindle 34 is used. The load sensor 40 comprises adjacent to the spring 45 a hall-chip 41 and a magnet 43 which are displaced with respect to each other and against the load of the spring 45. Dependent on the distance variation between the hall-chip 41 and the magnet 43, the varying magnetic field generates an electric signal in the hall-chip 41 which is calibrated on the load of the compressed spring 45 whereas the force of the spring 45 represents the mechanical load of the at least one brake cable 60 as already mentioned above. To this end, the hall-chip 41 is contained in a fixing 42 which is mounted on a housing 20 of the operating mechanism 1.

In the above-described preferred embodiment of the present invention, one brake cable 60 and the respective brake is operated by means of the operating mechanism 1. Fig. 5 shows a further preferred embodiment of the operating mechanism 1 which is used for the operation of two brake cables 60 at the same time. To this end, a coupling mechanism 80 being similar to the nut 35 is guided on the spindle 34. The coupling mechanism 80 comprises a nut with an arc-shaped outer surface on which a moveably slewable lever 84 is mounted. The nut with arc-shaped outer surface comprises an inner thread being complementary shaped to the thread of

the spindle 34. In the same distance from the center of the nut with arc-shaped outer surface, mounting facilities are arranged on both ends of the lever 84 on which a brake cable 60 is mounted, respectively. If the brake cables 60 are of different lengths or if they develop a different length because of a different strain behavior, the lever 84 slews so that the mechanical loads generated by the operating mechanism 1 are uniformly distributed on the brake cables 60 and the respective brakes in spite of the present differences in length of the brake cables 60. According to a further embodiment, it is also possible to movably mount the lever 84 in a different way on said above described nut 35 and, thus, a simpler shape of said nut 35 can be used. Based on this inventive arrangement, it is possible to use the operating mechanism 1 for the simultaneous operation of two brake cables 60 and the corresponding brakes. In this context, it is also conceivable to configure the coupling mechanism 80 capable to operate four brake cables. Additionally, a compact arrangement is provided which as a whole can be installed in the housing 20 and which is thus protected from outer influences.

Dependent on the length strain of the brake cables 60, on their different length adjustment and on the wear of, for instance, the brake lining, the nut 35 or the coupling mechanism 80 is displaced to different positions in direction of the gear wheel 31 for the generation of the same braking force. In case of a strong wear of the brake lining, the distance to the gear wheel 31 is, for instance, the smallest. In order to indicate this wear state, for instance, microswitches can be mounted on the edge of the gear wheel 31 opposite to the spindle 34 which are operated by the nut 35 or the coupling mechanism 80 in the special case. It is also conceivable, to mount these microswitches in appropriate distances on the housing 20 or on the spindle 34 so that they are also switched there by the nut 35 or the coupling mechanism 80.

List of reference signs

1	operating mechanism
5	electric motor
10	gear
20	housing
30	actuator
31	gear wheel
31a	concentric opening in the gear wheel
34	spindle
34a	profiled first end of the spindle
34b	second end of the spindle
34c	stopper
34d	rotation decoupled stopper
34G	thread of the spindle 34
35	nut
40	load sensor
41	hall-chip
42	hall-chip fixing
43	magnet
43a	magnet fixing
45	spring
70	Bowden cables
80	coupling mechanism
84	movable lever

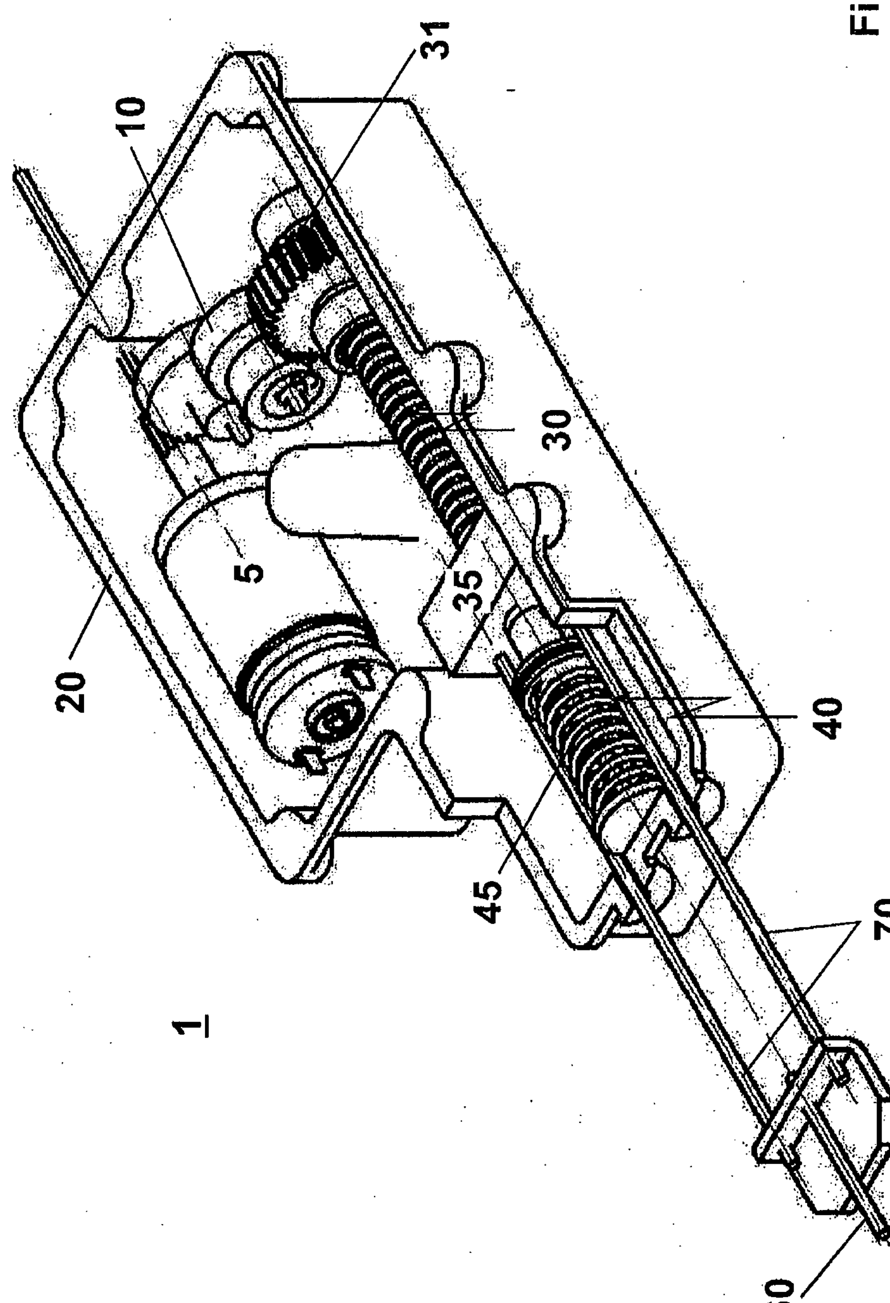


Fig. 1

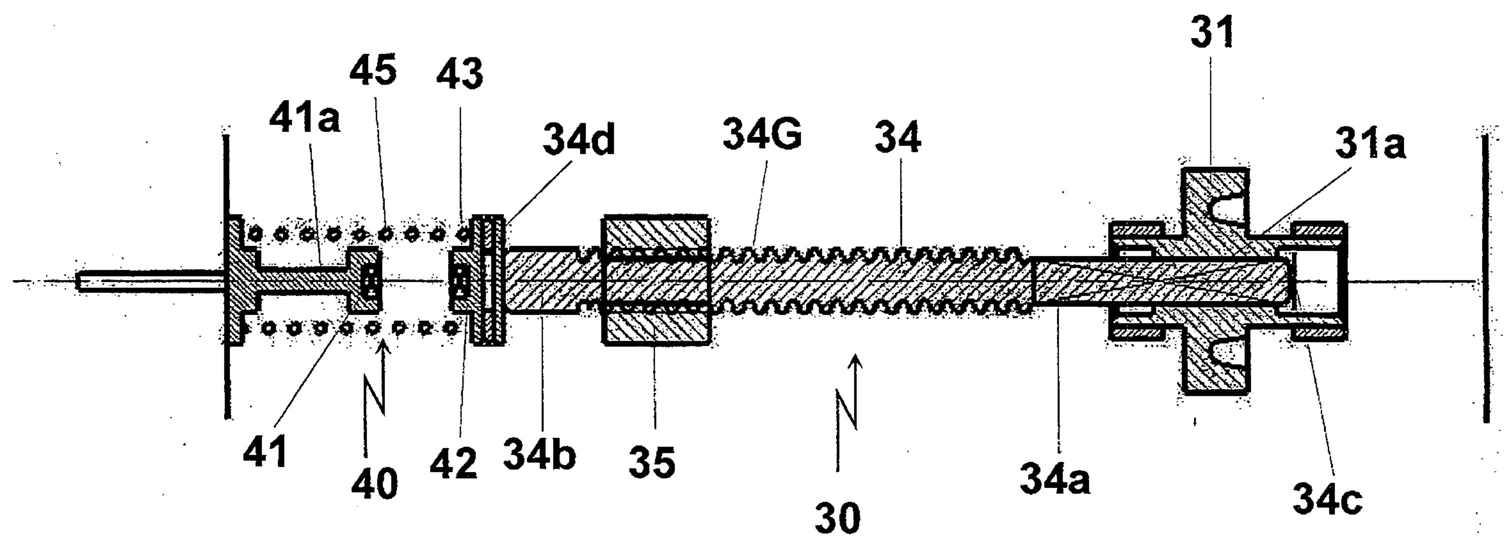


Fig. 2

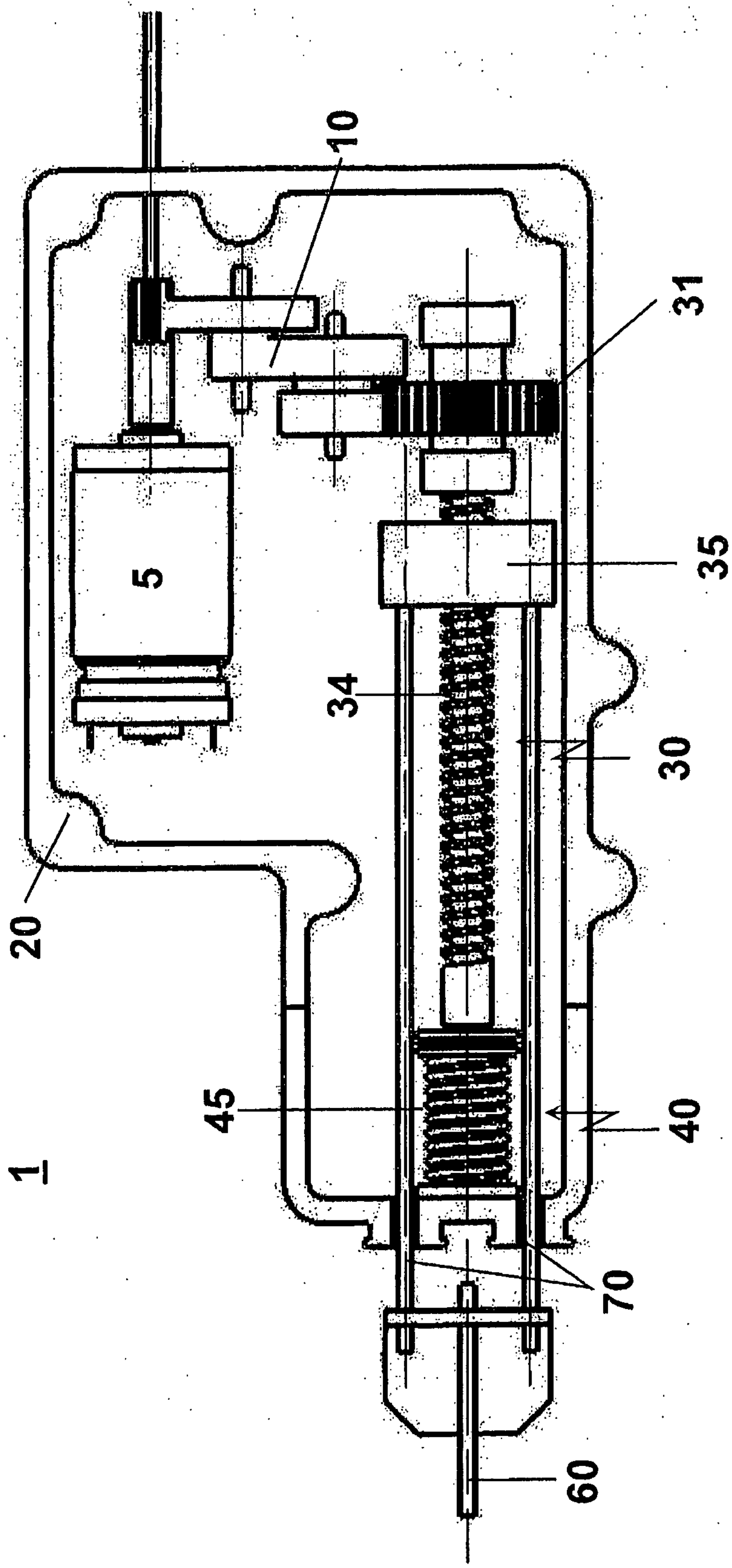


Fig. 3

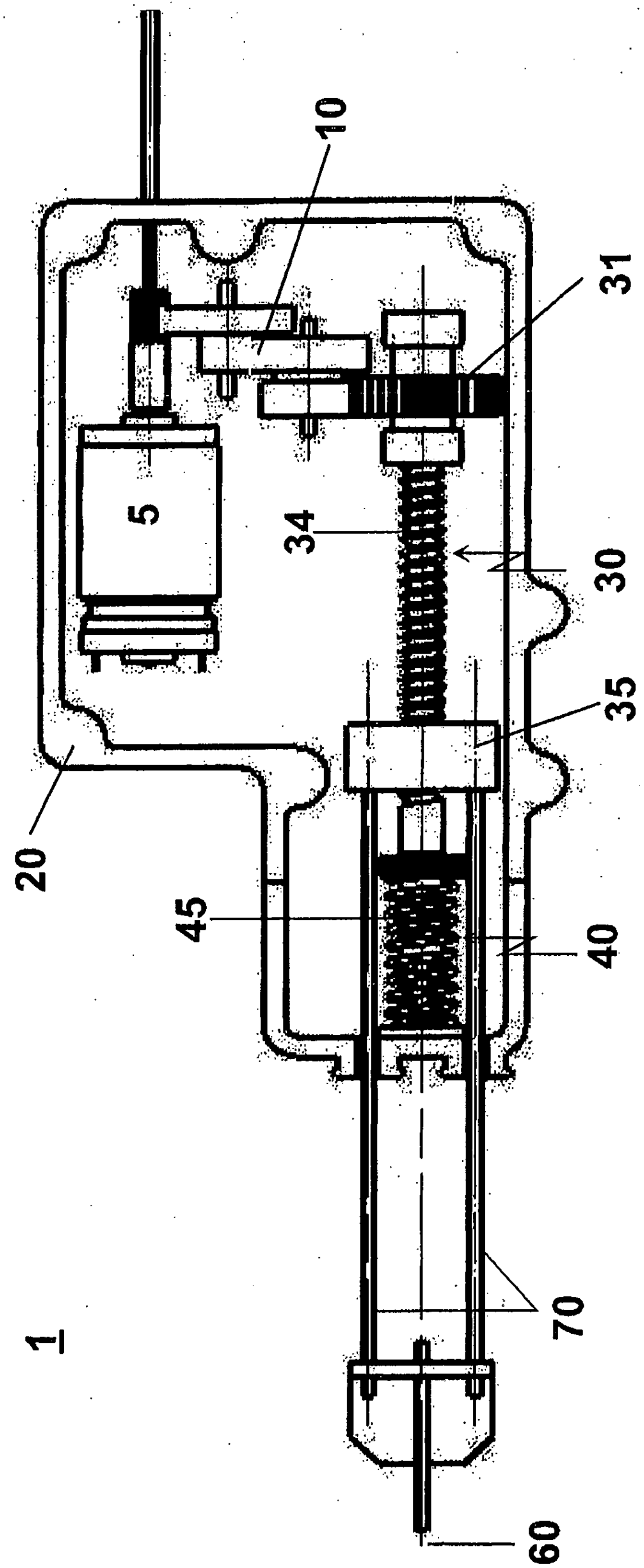
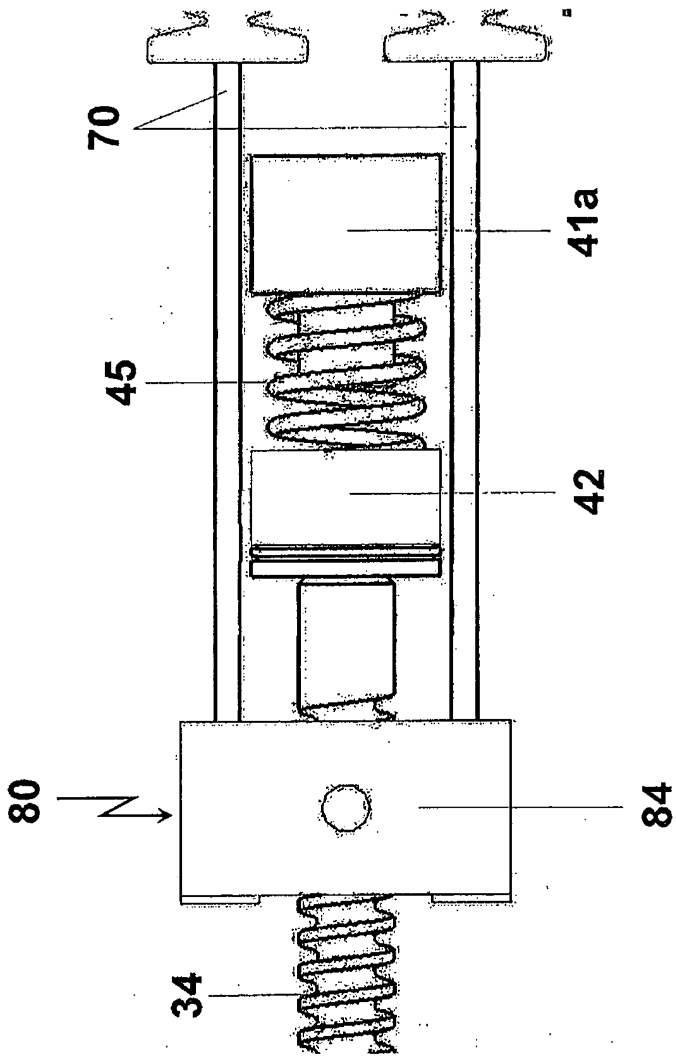


Fig. 4

Fig. 5



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Claims

1. An operating mechanism (1) for at least one brake, in particular a parking brake, comprising:

   a. an actuator (30) connected to at least one brake cable (60); and

   b. a load sensor (40) for determining the mechanical load of the at least one brake cable (60); wherein

   c. the mechanical load of the at least one brake cable (60) is determined via the actuator (30) in a manner decoupled from the at least one brake cable (60).

2. The operating mechanism (1) according to claim 1, characterized in that said actuator (30) is driven by an electric motor (5) via a gear (10).

3. The operating mechanism (1) according claim 1, characterized in that said actuator (30) changes its position in direction of its longitudinal axis dependent on the mechanical load of the at least one brake cable (60).

4. The operating mechanism (1) according claim 3, characterized in that said actuator (30) comprises a gear wheel (31), a spindle (34) and a nut (35).

5. The operating mechanism (1) according to claim 4, characterized in that a first end (34a) of said spindle (34) being complementary shaped to a concentric, profiled opening (31a) of said gear wheel (31) and being guided therein so that

a rotation of the gear wheel (31) is transmitted to said spindle (34) and that at the same time a displacement of said first end (34a) of said spindle (34) is possible in axial direction within said concentric, profiled opening (31a) of said gear wheel (31).

6. The operating mechanism (1) according to claim 5, characterized in that said first end (34a) of said spindle (34) comprises a stopper (34c) so that said spindle (34) cannot be completely removed from said concentric, profiled opening (31a) of said gear wheel (31).

7. The operating mechanism (1) according to claim 6, characterized in that said spindle (34) comprises a second end (34b) on which a rotation decoupled stopper (34d) is mounted.

8. The operating mechanism (1) according to claim 7, characterized in that said rotation decoupled stopper (34d) comprises a magnet fixing (43a) with a magnet (43).

9. The operating mechanism (1) according to claim 8, characterized in that a Hall-chip (41) in a Hall-chip fixing (42) is arranged opposite of and spaced apart from said magnet (43) wherein a spring (45) is positioned between said magnet fixing (43a) and said Hall-chip fixing (41a).

10. The operating mechanism (1) according claim 4, characterized in that a nut (35) is guided on a thread (34G) of said spindle (34) by a respective inside thread.

11. The operating mechanism (1) according to claim 10, characterized in that two Bowden cables (70) are coupled to said nut (35) via coupling facilities being symmetrically arranged to said spindle (34) wherein said Bowden cables (70) are connected to said at least one brake cable (60).

12. The operating mechanism (1) according to claim 4, characterized in that said nut (35) is configured as a coupling mechanism (80) comprising a nut with an arc-shaped outer surface and a movable lever (84) mounted thereon.

13. The operating mechanism (1) according to claim 12, characterized in that said movable lever (84) comprises coupling facilities for at least two brake cables (60) so that at least two brakes can be directly operated via said actuator (30).

14. The operating mechanism (1) according to one of the preceding claims, characterized in that micro switches are arranged along said spindle (34) or parallel to said spindle (34) on said housing (20) which are switched by said nut (35) or by said coupling mechanism (80) and thereby generate a signal which indicates that maintenance has to be carried out.

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Summary

The present invention relates to a operating mechanism (1) for at least one brake in particular a parking brake comprising an actuator (30), connected to at least one brake cable (60) and a load sensor (40) for determining the mechanical load of the at least one brake cable (60) wherein the mechanical load of the at least one brake cable (60) is determined via the actuator (30) and decoupled from the at least one brake cable (60). By the arrangement according to the present invention a direct connection between the actuator (30) and the brake cable (60) is provided wherein the load sensor (40) does not work as a load transmission or a coupling component. This arrangement meets high security requirements even in case of a failure of the load sensor (40) since the function of the operating mechanism (1) is not affected or prevented thereby.

Fig. 1